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STUDYING LEARNING PATTERNS IN MENTAL RETARDATES.

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DESCRIPTORS- *EXCEPTIONAL CHILD RESEARCH, *MENTALLY HANDICAPPED, *LEARNING, *REINFORCEMENT, CHILDREN, LEARNING CHARACTERISTICS, EDUCABLE MENTALLY HANDICAPPED, TRAINABLE MENTALLY HANDICAPPED, CUSTODIAL MENTALLY HANDICAPPED, INTELLIGENCE LEVEL, LEARNING PROCESSES, RETENTION, MEMORY, RECALL (PSYCHOLOGICAL), PERFORMANCE FACTORS, PERFORMANCE TESTS, REWARDS, TASK PERFORMANCE, TIME FACTORS (LEARNING), VERBAL LEARNING, PERCEPTUAL MOTOR LEARNING, MALES, FEMALES, LEARNING PROCESSES, COGNITIVE PROCESSES

FIVE EXPERIMENTS WERE CONDUCTED IN AN ATTEMPT TO ISOLATE SPECIFIC LEARNING PATTERNS IN CHILDREN OF VARYING DEGREES OF MENTAL RETARDATION AND TO CONTRIBUTE TO THE KNOWLEDGE OF THE PHYLOGENETIC DEVELOPMENT OF INTELLIGENCE. FACTORS STUDIED WERE THOSE KNOWN TO INFLUENCE LEARNING IN NORMAL CHILDREN AND ADULTS--KIND OF REINFORCEMENT (VERBAL OR PHYSICAL), DELAY OR REWARD, SHIFT OF REINFORCEMENT, INTERTRIAL INTERVAL, AND REMINISCENCE. THE SUBJECTS WERE MALE AND FEMALE INSTITUTIONALIZED RETARDED CHILDREN, AGED 8 TO 18, AND CLASSIFIED AS MILDLY, MODERATELY, OR SEVERELY RETARDED. GROUPS VARIED IN SIZE, AND WERE EVALUATED IN THE COMPLETION OF MOTOR OR VERBAL TASKS (PURSUIT MOTOR, PEGBOARD, MEMORY DRUM TASKS). CONCLUSIONS DRAWN FROM THE SERIES OF MOTOR TASK EXPERIMENTS WERE AS FOLLOW--(1) MALES GENERALLY ACHIEVE A PERFORMANCE LEVEL SIGNIFICANTLY SUPERIOR TO FEMALES, (2) DIFFERENT REWARDS DO LEAD TO SIGNIFICANT DIFFERENTIATION IN PERFORMANCE, (3) DELAY OF REWARD DOES NOT HAVE A SIGNIFICANT EFFECT ON THE PERFORMANCE OF RETARDATES WHEN A SENSORY REWARD (SUCH AS LIGHT) IS USED, (4) MILD RETARDATES PERFORM AT A LEVEL SIGNIFICANTLY SUPERIOR TO MODERATE RETARDATES, AND BOTH GROUPS ARE SUPERIOR TO SEVERE RETARDATES, (5) THE EXPECTED ELATION AND DEPRESSION AS A RESULT OF A SHIFT IN REINFORCEMENT DO NOT APPEAR TO OCCUR IN RETARDATES, ALTHOUGH THESE SUBJECTS DO SHOW AN INTEREST EFFECT OR IMPROVEMENT IN PERFORMANCE FOLLOWING ANY SHIFT IN REINFORCEMENT, (6) THE LENGTH OF INTERTRIAL INTERVAL DOES NOT SIGNIFICANTLY AFFECT THE PERFORMANCE OF RETARDATES WHEN INTERVALS OF 10 SECONDS OR LESS ARE USED, (7) RETARDATES DO NOT SHOW A REMINISCENCE EFFECT IN VERBAL LEARNING, BUT THERE IS SOME INDICATION THAT THE REMINISCENCE DOES OCCUR IN MOTOR LEARNING, AND (8) AGE, IQ, AND MENTAL AGE CANNOT BE USED AS ACCURATE PREDICTORS OF PERFORMANCE ON EITHER VERBAL OR MOTOR TASKS. DATA ARE PRESENTED IN 17 TABLES AND 12 FIGURES. A BIBLIOGRAPHY LISTS 103 ITEMS. (DF)

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Cooperative Research Project No. 2880

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1967

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Table 1

		CA(yrs-mos)	IQ	MA (yrs-mos)
Mild	Males	14-7.1	58.20	7- .1
	Females	14-7.8	56.93	6-10.5
Moderate	Males	13-11.6	42.33	4-6.8
	Females	14-11.5	41.60	4-8.2
Severe	Males	14-3.4	26.71	2-9.0
	Females	14-8.1	29.50	3-3.2

Table 2

Source	Sums of squares	df	Mean square	F	p
A (sex)	2027.10	1	2027.10		
B (retardation)	39318.33	1	39318.33	23.220	<.01
C (acquisition-retention)	1204.50	1	1204.50	21.914	<.01
D (reinforcement)	7496.44	2	3748.22	41.680	<.01
A X B	7.76	1	7.76		
A X C	28.27	1	28.27		
A X D	57.97	2	28.98		
B X C	.05	1	.05		
B X D	627.30	2	313.65	3.488	<.05
C X D	2372.93	2	1186.46	7.068	<.05
A X B X C	.88	1	.88		
A X B X D	27.40	2	13.70		
A X C X D	9.88	2	4.94		
B X C X D	6.90	2	3.45		
A X B X C X D	1.87	2	.93		
Ss within group	94823.72	56	1693.28		
C X S within group	3078.48	56	54.96		
D X S within group	10072.02	112	89.92		
CD X S within group	18801.86	112	167.87		

Table 3

Source	Sums of Squares	df	Mean square	F	p
A (sex)	17.09	1	17.09	4.211	<.05
B (retardation)	.99	1	.99		
C (acquisition-retention)	.13	1	.13		
D (reinforcement)	8.71	2	4.35		
A X B	6.41	1	6.41		
A X C	.78	1	.78		
A X D	4.38	2	2.19		
B X C	4.85	1	4.85		
B X D	7.02	2	3.51		
C X D	20.03	2	10.01		
A X B X C	.06	1	.06		
A X B X D	5.72	2	2.86		
A X C X D	19.15	2	9.57		
B X C X D	20.34	2	10.17		
A X B X C X D	5.33	2	2.16		
Ss within group	227.30	56	4.05		
C X S within group	129.04	56	2.30		
D X S within group	417.84	112	3.73		
CD X S within group	995.65	112	8.89		

Figure 1

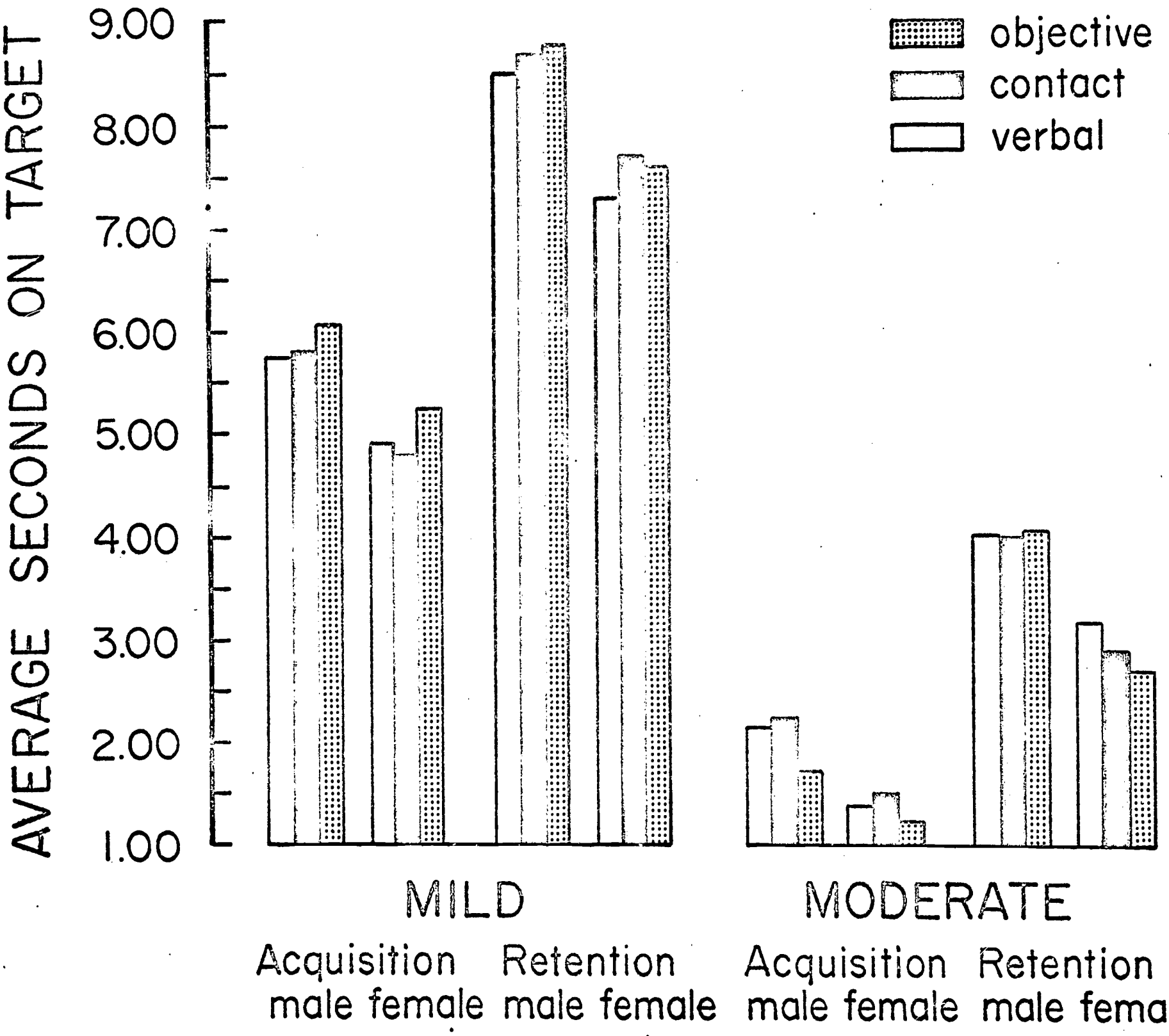

AVERAGE SECONDS ON TARGET
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
objective
contact
verbal
MILD
MODERATE
Acquisition Retention
male female male female
Acquisition Retention
male female male female

Table 4

		CA-Score	IQ-Score	MA-Score	Acquisition-retention
Mild	Males	.123	.676**	.427	.786**
	Females	-.112	.345	.294	.903**
Moderate	Males	.403	.082	.371	.822**
	Females	.168	.662**	.598*	.900**
Severe≠	Males	-.170	.795*	.607	1.000**
	Females	.188	.167	.164	.697*

* p<.05

**p<.01

≠The number of subjects in the severe groups was as follows: male, 7; female, 10. Due to the inability of some severe subjects to complete the task, the results of all fifteen subjects in each group could not be reported.

Table 5

		CA (yrs-mos)	IQ	MA (yrs-mos)
Mild	Males	14-7.0	58.20	7-1.6
	Females	14-7.8	56.93	9-9.7
Moderate	Males	14-1.9	42.53	4-7.9
	Females	14-10.8	41.80	4-8.0
Severe	Males	14-1.5	26.27	2-9.3
	Females	14-8.0	28.80	3-2.0

Table 6

Source	Sums of squares	df	Mean square	F	p
A (sex)	287.46	1	287.46		
B (retardation)	31628.84	2	15814.42	29.024	<.01
C (acquisition-retention)	52.28	1	52.28		
D (reinforcement)	157.00	2	78.50	3.673	<.05
A X B	239.81	2	119.90		
A X C	10.15	1	10.15		
A X D	15.85	2	7.92		
B X C	93.08	2	46.54		
B X D	148.86	4	37.21		
C X D	43.37	2	21.68		
A X B X C	17.60	2	8.80		
A X B X D	134.52	4	33.63		
A X C X D	2.23	2	1.11		
B X C X D	45.84	4	11.46		
A X B X C X D	155.58	4	38.89		
Ss within group	45769.09	84	544.87		
C X S within group	1701.23	84	20.25		
D X S within group	3590.11	168	21.37		
CD X S within group	9063.98	168	53.95		

Table 7

Source	Sums of squares	df	Mean square	F	p
A (sex)	6.01	1	6.01	3.629	<.05
B (retardation)	5.62	2	2.81		
C (acquisition-retention)	1.55	1	1.55		
D (reinforcement)	7.44	2	3.72		
A X B	1.14	2	.57		
A X C	.31	1	.31		
A X D	2.74	2	1.37		
B X C	2.55	2	1.28		
B X D	2.92	4	.73		
C X D	14.78	2	7.39		
A X B X C	3.91	2	1.95		
A X B X D	7.61	4	1.90		
A X C X D	1.33	2	.66		
B X C X D	11.68	4	2.92		
A X B X C X D	3.01	4	.75		
Ss within group	139.26	84	1.65		
C X S within group	163.49	84	1.94		
D X S within group	313.60	168	1.86		
CD X S within group	803.93	168	4.78		

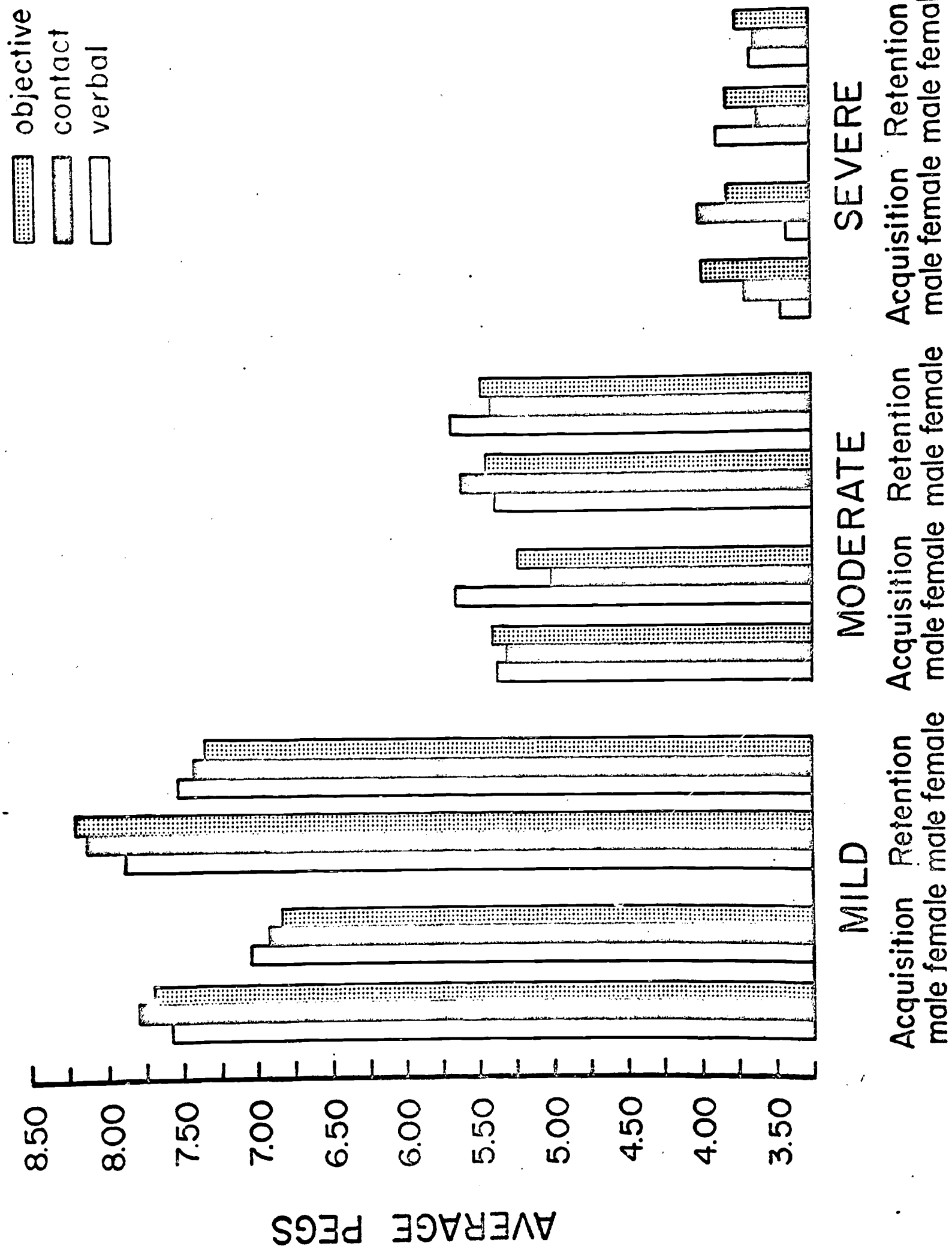
Table 8

		CA-Score	IQ-Score	MA-Score	Acquisition-retention
Mild	Males	.495	.704**	.723**	.871**
	Females	-.091	.452	.480	.962**
Moderate	Males	.556	.462	.612*	9.06**
	Females	.393	.317	.513	.915**
Severe	Males	-.097	.607*	.681**	.789**
	Females	.150	.280	.349	.738**

* $p < .05$

** $p < .01$

Figure 2


objective
contact
verbal
AVERAGE PEGS
8.50
8.00
7.50
7.00
6.50
6.00
5.50
5.00
4.50
4.00
3.50
MILD
Acquisition Retention
male female male female
MODERATE
Acquisition Retention
male female male female
SEVERE
Acquisition Retention
male female male female

Studying learning patterns in mental retardates[1]

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This paper consists of five experimental reports in which we have attempted to isolate specific learning patterns in children of varying degrees of retardation. The purpose of these studies is both practical and theoretical. On the practical level, the assumption is sometimes made that retardates differ in learning ability from normal children primarily in quantity of intelligence. That is, retardates are retardates because they are able to learn less than a normal child. For example, consider the learning of the task to count from "one" to "ten" in order. To say that the retardate learns less implies that, given the same amount of time as the normal child, the retardate is only able to learn part of the counting sequence, from "one" to five" for example. Thus, under the same conditions, the retardate learns quantitatively only half that of the normal child. It is likely, however, that retardates also differ from normal children in qualitative measures of learning. For example, assuming that both the retarded child and the normal child can count to "five",

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[2] We are grateful to Selinsgrove State School and Hospital, Selinsgrove, Pennsylvania, to Philip Bossart, Ph.D., of the department of psychology of that institution, to Daniel L. Kirk, M.D., Superintendent, and to Laurelton State School and Hospital, Laurelton, Pennsylvania, to John Quackenbush, Ph.D. and to Bernard Newell, M.D., Superintendent, for their cooperation in providing subjects.

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it is likely that the normal child can apply the process of counting to many more stimuli than can the retarded child. In this example, the children differ in the quality of learning, but not in the quantity. If it is true that both kinds of learning distinguish the normal from the retarded child, it is unfortunate that many teaching devices are based on the quantitative, rather than the qualitative, attributes of learning. Teaching and training techniques, especially programmed instruction, which concentrate on repetition and those which employ the immediate presentation of knowledge of results or approval from the instructor may be inefficient because they do not use techniques which produce maximal learning in the retardate. Many of these devices and approaches are constructed on the basis of the learning processes of the normal child. One purpose of these reports is to determine the maximally efficient procedures for training the retardate.

A second purpose of these experiments is to contribute to our knowledge of the phylogenetic development of intelligence. The material on human learning which has accumulated has emphasized, until recently, the performance of the college student who should be of higher intelligence than the average person at that age. There is no reason to suppose that the principles of efficient learning which apply to this select group would also apply completely to the learning patterns of retardates. Moreover, as we learn more about phylogenetic development of intelligent and adaptive behavior, it becomes evident that the nature of those variables which combine in the appropriate proportion to produce efficient learning provides clues as to the development of intelligence.

These studies consider learning phenomena which are known to be influential in efficient learning in normal children and adults. They are (1) the influence of the kind of reinforcement employed, whether verbal

approbation or a physical stimulus, (2) the effect of the duration of the delay of reward on performance: what is the optimal and most efficient time lapse between the correct response and the presentation of the reinforcement?, (3) the effect of altering the quantity of reinforcement: what happens to performance when a subject is shifted suddenly from a low reward to a high reward, and the reverse?, (4) the role of intertrial interval: does spacing trials have a beneficial effect on the efficiency of learning?, and (5) does the phenomenon "reminiscence" occur in forgetting?

Experiment I

The role of reinforcement

This study was concerned primarily with the possible differential effects of reinforcement on the motor performance of retarded subjects. By "reinforcement" we refer to those stimuli which, when presented with or following the desired performance, have been shown to lead to an increase in the rate or quality of the performance. Reinforcement in this study was verbal praise, objective reward or physical contact. The study also measured the effects of the sex of the subject and of IQ.

The relationship between sex and motor performance has not been clearly established. Although some investigators (Ammons, Alprin & Ammons, 1955; Archer & Bourne, 1956) have found differences between the sexes in performance, other investigators (Blackman & Kahn, 1963; Rabin, 1957; Sloan, 1951) have failed to find any sex differences. It would appear that sex differences, should they exist, are sensitive to the specific task. For that reason, sex is a dependent variable in this and succeeding studies. Although it is clear that intelligence level has a significant effect on performance when comparing normals and retardates (Stevenson & Cruse, 1961; Sloan, 1951), there is little evidence on the effect of IQ levels when comparing different retardate groups. Brace (1948) found a slight relation between IQ and motor performance when comparing females of different retardation levels.

The value of objective reward is well established for sub-human subjects (Hulse, 1958; Hill & Spear, 1962; Hill, Cotton & Clayton, 1962; Armus, 1959; Logan, Beier & Ellis, 1955; Wolfe & Kaplon, 1941). The value to normals and retardates, is not so apparent. Brackbill, Kappy & Starr (1962) and Siegel & Andrews (1962) found objective reward to have a positive effect, although Wolfensberger (1960) failed to find an effect. The results of verbal reinforcement studies show the same ambiguity. Some experimenters found verbal reinforcement to have a positive effect (Zigler, Hodgden & Stevenson, 1958; Chase, 1932; Ellis & Distefano, 1959; Gordon, O'Connor & Tizard, 1954, 1955; Terrell & Kennedy, 1957). Other experimenters have failed to find such an effect (Zigler & Unell, 1962; Ring & Palermo, 1961). The fact that certain studies failed to find positive effects may be due to the type of task used. Zigler & Unell (1962), who failed to find any effect, studied concept formation. Most of the studies which found positive effects used motor tasks. The trend suggests that verbal and objective reward do have positive effects on performance in most, but not all, situations.

Contact reinforcement has rarely been used as a reinforcer for human subjects. However, the work of Candland (Candland, Faulds, Thomas & Candland, 1960; Candland, Horowitz & Culbertson, 1961), Harlow & Zimmermann (1959) and McKinney & Keele (1963) indicates the importance of this variable.

The present study was concerned primarily with whether or not the reinforcements used would have a differential effect on performance. In this area, too, the literature is indecisive. Blackman & Kahn (1963, Ellis & Distefano (1959), Gordon, O'Connor & Tizard (1954, 1955) and Zigler, Hodgden & Stevenson (1958) all obtained results in which various rewards led to differential performance in retardates. Wolfensberger (1960), Ring & Palermo (1961), Stevenson & Fahel (1961) and Zigler & Unell (1962) failed to find these differential effects.

A possible reason for the lack of consistency of the results reported here may be due to the great variability of the retardates' performance. This variability may be caused by poor control and balancing of the subjects in regard to the IQ, MA and CA factors. Most experimenters use at least one of these factors in equating their groups, but rarely are all three used. Problems in diagnosis of subjects in regard to the type of retardation may also affect variability. The present experiment, although unable to control for problems of diagnosis, has attempted to control CA, MA and IQ factors in order to obtain stable results regarding the differential effectiveness of various types of reinforcements.

Experiment IA

Method

Subjects. Thirty mildly and thirty moderately retarded subjects were used in this experiment. Mild retardates were defined as having an IQ range of 53 to 69 and moderates had an IQ range of 36 to 53 (as measured by the Stanford-Binet and Wechsler tests). Half of the subjects in each retardate group were males and half were females. Thirty severe retardates were also tested. Of these, only ten females and seven males were able to perform the task. Table 1 shows the average CA, IQ and MA for the subjects in the experiment.

Table 1

Procedure. The subjects in each retardate group were divided into six groups of five each. Each group had three males and two females or three females and two males. The groups differed only in the order in which they received the reinforcements. During acquisition, the subjects were all given three sets of five 20 second trials on a standard pursuit rotor apparatus (consisting of a turntable, stylus and electric timer to measure time on target). Each of the three sets was reinforced by a

different reinforcer. The subjects received reinforcement after every trial on which they showed improvement. The reinforcements which were used were verbal ("very good"), objective (one M&M candy) and physical contact (teddy bear). Before each set, the subject was told which reinforcement he would receive on that set. After each series of trials, the subjects were given a rest period of ninety seconds. Retention was measured 24 hours after the acquisition series. The same procedure was followed during retention as during acquisition.

Results

An analysis of variance was conducted on the results. Two different measures were analyzed: total time on target per set (Table 2) and intraset savings (final score during set minus initial score during set; Table 3). In terms of the total time measure, the mild retardates were

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Tables 2 and 3
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found to perform significantly better than the moderates. There were also significant differences between the three reinforcements, with the objective reward being superior and the verbal reward being inferior. Retention was found to be significantly superior to acquisition.

A significant sex difference was found in the intraset savings score, with the males being superior.

Figure 1 shows the results of the study in terms of average seconds

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Figure 1
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on target per trial as a function of the reinforcement. The differences between the males and the females and between acquisition and retention should be noted.

Table 4 shows the results of the correlations between performance and IQ, MA and CA. The score represents the total time on target for both

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Table 4
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acquisition and retention. The only consistent significant relations found were between acquisition and retention.

Discussion

The significant differences between males and females and between acquisition and retention may be seen graphically in Figure 1. In this type of motor coordination task, males perform at a higher level than females of comparable CA, MA and IQ.

The difference between acquisition and retention appears to reflect a reminiscence effect. In every case, there was an improvement in retention performance over the performance during the acquisition trials which took place twenty-four hours earlier (see Experiment V). It should be pointed out that this may be due to the subjects' own emotional state, rather than to reminiscence. The second time the subjects were taken to be tested they were more familiar with both the test situation and the experimenter, and therefore less excited. This may have contributed to the difference between acquisition and retention performance.

The analysis of variance of total time showed a significant difference among the reinforcements with the objective leading to superior performance and the verbal leading to inferior performance. This difference was largely due to the mild group. As may be noted from Figure 1, the objective reward was superior to the verbal in every case for the mild retardates. Although the same relationship is not found for the moderates, the differences for the mild groups were large enough to lead to a significant difference.

The most consistent results among correlations is found between acquisition and retention. Of the three measures correlated with the score, IQ appears to be the best predictor of level of performance. But a significant correlation between IQ and score is not found consistently. Therefore the value of this measure as a predictor of motor performance

should not be overrated.

Experiment IB

Method

In order to determine the effect of the task, a further study was undertaken using a motor task distinct from the pursuit rotor.

Subjects. Thirty mild, thirty moderate and thirty severe retardates were used in this study. There were fifteen males and fifteen females in each retardate group. Table 5 shows the average CA, IQ and MA for the groups.

Table 5

Procedure. The subjects were all tested on a pegboard task. The apparatus consisted of round pegs, one side painted orange and the other side blue, and a board in which round holes were cut. The subjects were instructed to place the pegs into the board with the orange side up as fast as they could.

The subjects in each retardate group were divided into six groups of five. Each group had three males and two females or three females and two males. The groups differed only in the order in which they received the reinforcements. The reinforcements used were verbal ("very good"), physical contact (teddy bear) and objective (one M&M candy). During acquisition, the subjects all received three sets of five 15 second trials. They were reinforced for every trial, regardless of whether they showed improvement or not. Before each set they were informed of the type of reinforcement they would receive during that set.

Retention took place 48 hours after acquisition. The same procedure was followed during retention as during acquisition.

Results

Analysis of variance was performed on two different measures:

total pegs per set (Table 6) and intraset savings (Table 7). In terms of

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Tables 6 and 7
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total pegs, a significant difference was found among the three types of retardates. There was also a significant difference among the three reinforcements with the objective reward being superior and the verbal reward being inferior. This was also found in the previous experiment. In terms of intraset savings score, the males were significantly superior to the females, as was true of the previous experiment.

Figure 2 shows the results of the experiment in terms of average

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Figure 2
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pegs per trial for the three retardate groups. As is clear from the graph, the significant differences among the reinforcements are primarily due to the severe-group performance, where the objective reward was consistently superior to the verbal.

Table 8 shows the results of the correlations. Score equals the total pegs for both acquisition and retention. Both acquisition and

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Table 8
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retention are in terms of total pegs. No consistent significant relations were found except between acquisition and retention.

Discussion

The analysis of variance showed significant differences for sex, retardation level and reinforcement. It is interesting to note from the graph that the effect of sex on performance decreases as the degree of retardation increases. The same is also true of the differences between acquisition and retention.

Although the analysis of variance showed objective reinforcement to

be significantly superior, the effect of the different reinforcement conditions throughout the groups is not consistent. Further study is needed before any generalizations about the effects of these rewards can be made safely.

The correlations fail to show any consistent significant differences, except in the case of acquisition and retention. The MA seems to be the best predictor. However, the value of this measure as a predictor cannot be fully determined without further examination.

Summary and conclusions

Two experiments were conducted in order to examine the variables of sex, degree of retardation, CA, MA, IQ and reinforcement on performance. The two experiments were identical with three exceptions. First, there was a difference in the task used. The first experiment used the pursuit rotor. In the second experiment, the subjects were tested on a pegboard task. This change was made in order that severe retardates could be tested, since they were unable to perform the pursuit rotor task. The change was also made to see if a different task would alter the results. The second difference dealt with the number of reinforcements given each subject. In the first experiment the subjects were reinforced for every trial on which they showed improvement. In the second experiment the subjects were reinforced for every trial. This change was made in order to equate the number of reinforcements which each subject received. The third difference had to do with the acquisition-retention interval. In the first experiment the interval was 24 hours; in the second it was 48 hours. This change was made due to problems in scheduling.

The following results were found:

1. Males perform significantly better than females on these types of motor tasks.

2. Retention was found to be significantly superior to acquisition

in the first experiment, but not in the second. The longer retention interval in the second experiment appears to be less beneficial to retention than the 24 hour interval.

3. Significant differences were found among the three reinforcements for both studies. The objective reward was superior and the verbal reward was inferior. The inferior effect of the verbal reinforcement may be attributed partially to the limited verbal behavior of the retarded child.

4. Correlations failed to show that either CA, IQ or MA can be used as reliable predictors of performance on motor tasks. Acquisition, however, appears to be a reliable predictor of retention score.

5. The differences between the sexes and between acquisition and retention appear to decrease as the degree of retardation increases.

Experiment II

Delay of reward

The fact that delay of reinforcement affects learning has been well established. Conant (1960), Logan (1952), Perin (1943a, 1943b) and Seward & Weldon (1953) have all found that bar pressing performance in rats decreases as delay of reward increases. The same relation between performance and delay has been found by Grice (discrimination box, 1948) and Wolfe (maze and discrimination box, 1934). Perin's work (1943a, 1943b) indicates that delays of from twenty to thirty seconds will prevent many subjects from learning the bar pressing task or will cause the subjects to extinguish. Grice's (1948) subjects were unable to learn with a ten second delay. Warden & Haas (1927) failed to find the expected relation between delay and performance. They found that a one minute delay was detrimental to performance (when compared to a 0 delay),

yet the five minute delay caused no decrease in performance. Their results appear to be invalidated by a sampling error, for the difference in the one minute delay group appears to be due to the performance of one animal.

The results on delay of reinforcement in studies with human subjects indicate the same relation between delay and performance. Bilodeau (1956), Lipsitt & Castaneda (1958), Saltzman (1951) and Sax (1960) all found that an increase in delay led to a decrease in performance. Hockman & Lipsitt (1961) found this relation to hold for a difficult task (three-stimulus discrimination) but failed to find any difference in performance for an easier task (two-stimulus discrimination).

When testing subjects using a task in which the subjects were required to hit a target, Alexander (1960) and Lorge & Thorndike (1935) failed to find that delay of knowledge of results affected performance. This was probably due to the fact that all subjects received immediate knowledge of results from their body position and movement cues.

The results of these studies clearly indicate that there is a negative correlation between length of delay and level of performance. The purpose of this study is to find if the same relation holds for retarded children.

Method

Subjects. Twenty-four mild retardates and twenty-four moderate retardates were used as subjects. One half of the subjects in each group were males and one half were females. The average CA, IQ and MA of the subjects are shown in Table 9.

Table 9

Procedure. The subjects in each level of retardation were divided into four groups. Each group consisted of three males and three females. These groups were matched on the basis of CA, IQ and MA, as well as on

Table 9

		CA (yrs-mos)	IQ	MA (yrs-mos)
Mild	Males	14-5.7	59.67	7-4.5
	Females	13-10.8	58.58	6-8.2
Moderate	Males	15- .7	45.92	5-8.2
	Females	15- .1	44.42	5-1.8

a pretest score. The groups differed only in the length of delay of reward. The reward was a red light on the apparatus. Delays of 1, 3, 5 and 10 seconds were used. The standard pursuit rotor apparatus, described in Experiment IA, was used. This apparatus was wired to an additional timer which turned on the red light after the desired delay interval.

The subjects were brought into the testing room individually and were instructed briefly on the task. No practice trial was given for all the subjects had previous experience with the pursuit rotor. They were told that when they did well, the red light attached to the apparatus would come on. They were not informed of the possibility of delay of the reinforcement. All subjects received three sets of five twenty second trials. They were rewarded on every trial on which performance surpassed that of previous trials.

Results

Analysis of the data revealed that the only significant difference was between the performance level (in terms of average seconds on target per trial) of the mild and moderate retardates ($p<.05$), with the milds showing superior performance (Table 10). Figure 3 shows the results in

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Table 10
---

terms of average seconds per trial as a function of the length of delay.

Figure 3

Table 11 shows the results of the correlations between CA, IQ, and MA and score.

Table 11

Table 10

Source	Sums of squares	df	Mean square	F	p
A (sex)	45.416	1	45.416		
B (delay)	17.694	3	5.898		
C (retardation)	153.475	1	153.475	4.81	<.05
A X B	5.713	3	1.904		
A X C	11.183	1	11.183		
B X C	11.640	3	3.800		
A X B X C	23.471	3	7.823		
Within	1020.284	32	31.884		
Total	1288.876	47			

Figure 3

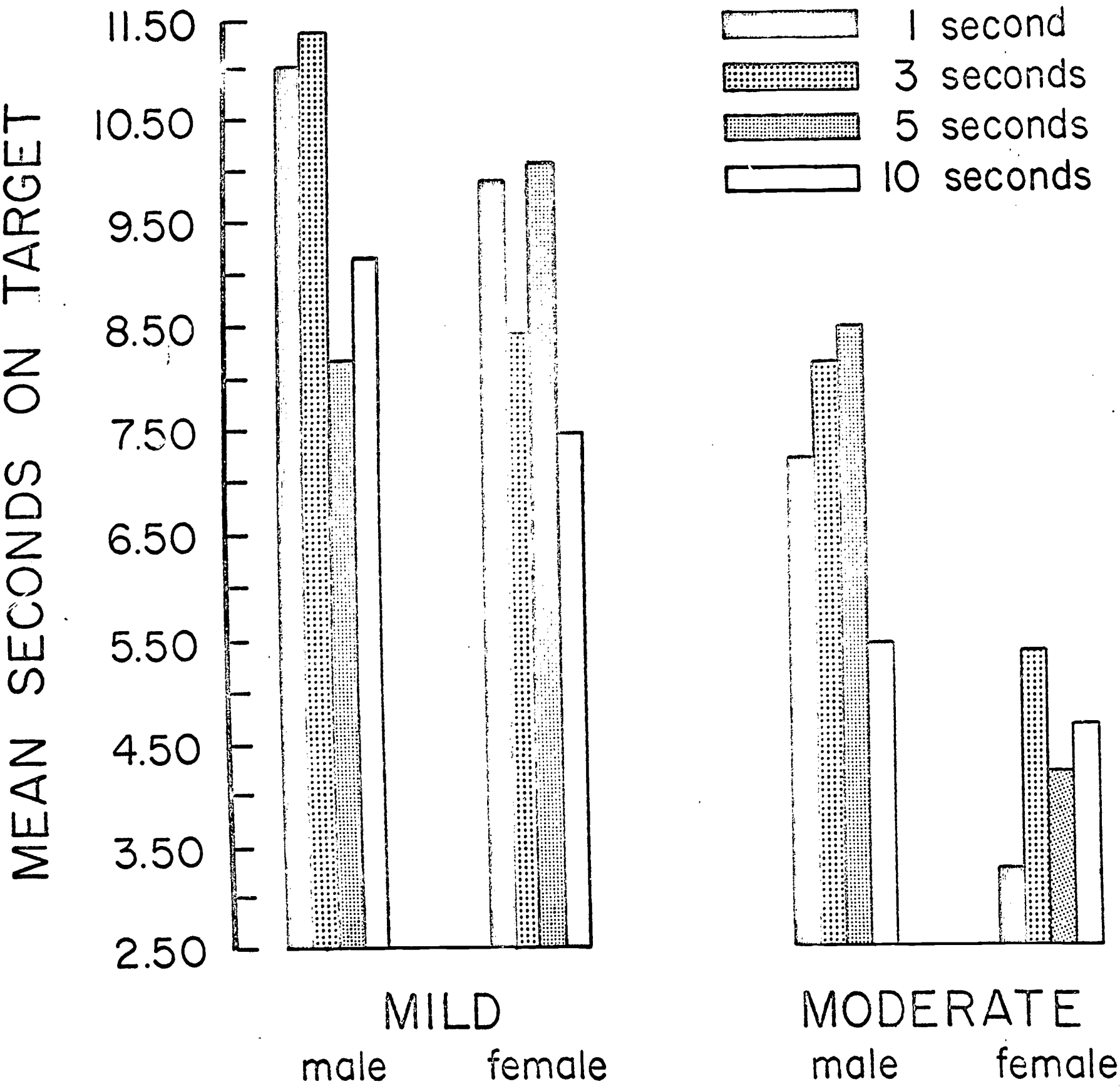

MEAN SECONDS ON TARGET
11.50
10.50
9.50
8.50
7.50
6.50
5.50
4.50
3.50
2.50
1 second
3 seconds
5 seconds
10 seconds
MILD
male
female
MODERATE
male
female

Table 11

		CA-Score	MA-Score	IQ-Score
Mild	Males	.221	.227	.024
	Females	.471*	.591**	.231
Moderate	Males	.476*	.533**	.407*
	Females	-.316	.518**	.713**

* $p < .05$

** $p < .01$

Discussion

The results of this study do not show the clear differences in performance as a function of delay of reward that have been reported in the literature for sub-human animals and normal human beings. However, two trends are notable. In every group but one (female moderate) the one second delay was superior to the ten second delay. Secondly, in every group but one (female mild) the three second delay was superior to the one second delay. This suggests that a slight delay may be beneficial. The lack of a truly consistent relation between delay and performance and the lack of significance may be due to the subjects' familiarity with the task. Hockman & Lipsitt (1961) have pointed out that delay of reward has no significant effect if the task is a simple one. These subjects had previous experience with the pursuit rotor and it may, therefore, have seemed easy to them. In addition, the previous experience may have enabled them to judge their own progress in an efficient manner so that the experimenter's reward had little effect.

The results of the correlations show that MA is a fairly accurate predictor of this type of motor performance. However, further study of this factor is necessary.

Summary and conclusions

This experiment was conducted in order to examine the effects of delay of reward on motor performance of retardates. Delays of 1, 3, 5 and 10 seconds were tested. The effects of sex and degree of retardation were also examined.

The results were as follows:

1. No significant relationship was found between delay and performance. It was noted, however, that the one second delay generally led to a higher level of performance than did the ten second delay, and that

the three second delay was generally superior to the one second delay.

2. Significant differences were found between the mild and moderate retardates, with the mild retardates achieving a higher level of performance. This confirms the findings of the previous studies.

3. No significant differences in performance were found as a result of the sex of the subject.

Experiment III

Shift of reinforcement

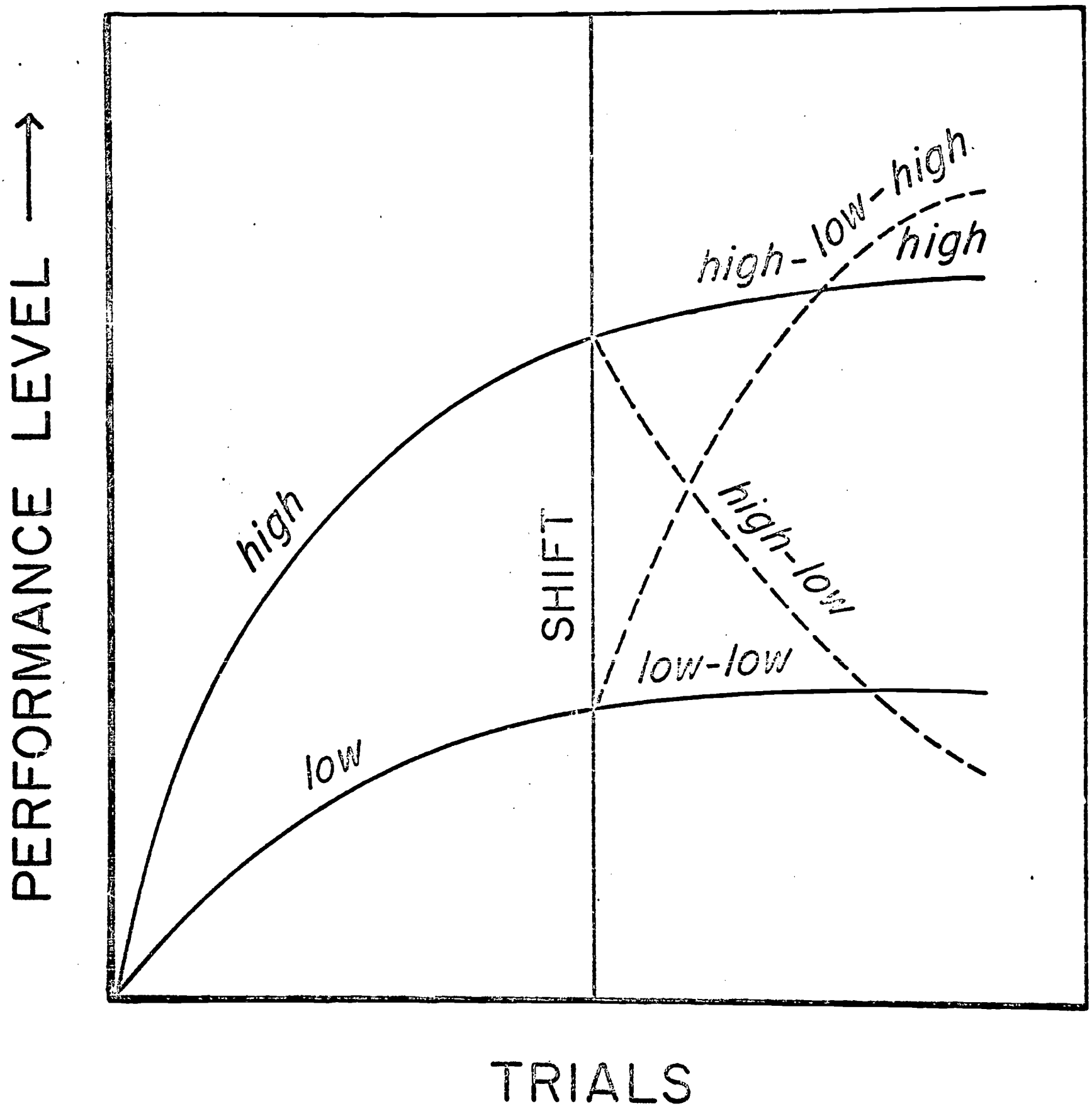
Crespi (1942) was the first experimenter to examine systematically the effect of a shift in reinforcement magnitude on performance. He found that an upward shift in reinforcement led to an elation effect. That is, after the shift, the organism reached a level of performance above that of an organism which had been receiving the high reinforcement throughout training. When a downward shift was instituted, performance showed a depression effect. The general paradigm of this effect is shown in Figure 4.

Figure 4

Ehrenfreund & Badia (1962) studied the effect of reinforcement shifts in rats as a function of deprivation (percent body weight). The subjects deprived to 85% body weight showed significant elation and depression effects ($p < .05$). The subjects deprived to 95% body weight, however, failed to show either effect. Metzger, Cottor & Lewis (1957) failed to find any elation or depression effect.

Some work on the Crespi effect has been done with retardates, but again inconsistent results have been obtained. Heber (1959) found a significant increase and decrease in performance as a result of upward and downward shifts. However, he found no significant elation or

Figure 4


PERFORMANCE LEVEL
high
low
SHIFT
high-low-high
high
high-low
low-low
TRIALS

depression effects. Stevenson & Snyder (1960) also found an increase in performance with an upward shift, but there was no elation effect. Their subjects showed only a small decrease with the downward shift. O'Connor & Claridge (1958) found an elation effect, but no depression effect. Spradlin (1962) failed to find any significant differences as a result of change in reinforcement level.

The results from these studies are far from conslusive; indeed, they are contradictory. However, they do seem to indicate that the upward shift has some effect on retardate performance. The present series of studies was conducted in order to examine more closely the effects of magnitude shifts. Three experiments were conducted on the Crespi effect. In the first experiment, all subjects were given the same number of reinforcements (if in reinforcement groups) and the same number of trials before the shift. Two levels of reinforcement were used: one M&M candy and no candy. In the second experiment, two levels of performance were introduced in order to discover if this had any effect on the performance after shift. Half of the subjects worked to a criterion of 50% improvement over the average for the first five test trials and the other half worked to an asymptotic level before shift. Reinforcement levels in this experiment consisted of one or three M&M candies. The third experiment represented a further refinement on the level of performance variable. In the second experiment, subjects were allowed to finish the five-trial set during which they reached criterion or asymptote. In the third experiment, the subjects were stopped on the trial on which they reached criterion or asymptote.

Experiment IIIA

Method

Subjects. Thirty-two retarded subjects were used in this experiment.

All subjects had IQs ranging from 45 to 78 and were between nine and sixteen years old.

Procedure. The subjects were tested on the pursuit rotor apparatus. The subjects were divided into four reinforcement level groups: upward shift (NR), downward shift (RN), high (RR) and low (NN). High reinforcement consisted of one M&M candy (R) and low reinforcement consisted of no candy (N). All subjects received five sets of five twenty-second trials. The shift in reinforcement, if scheduled, took place at the end of the second set of trials. The subjects were not informed at the beginning of the set that a shift in reinforcement would occur, so the effects of the shift are not apparent until the fourth set of trials. The subjects were brought to the testing room individually and the use of the apparatus was explained. Each subject was allowed one practice trial. They were told that if they did well, they would receive candy. The female subjects were tested by a female experimenter and the male subjects were tested by a male experimenter.

Results

The data from this experiment are plotted in Figure 5 in terms of

---
Figure 5
---

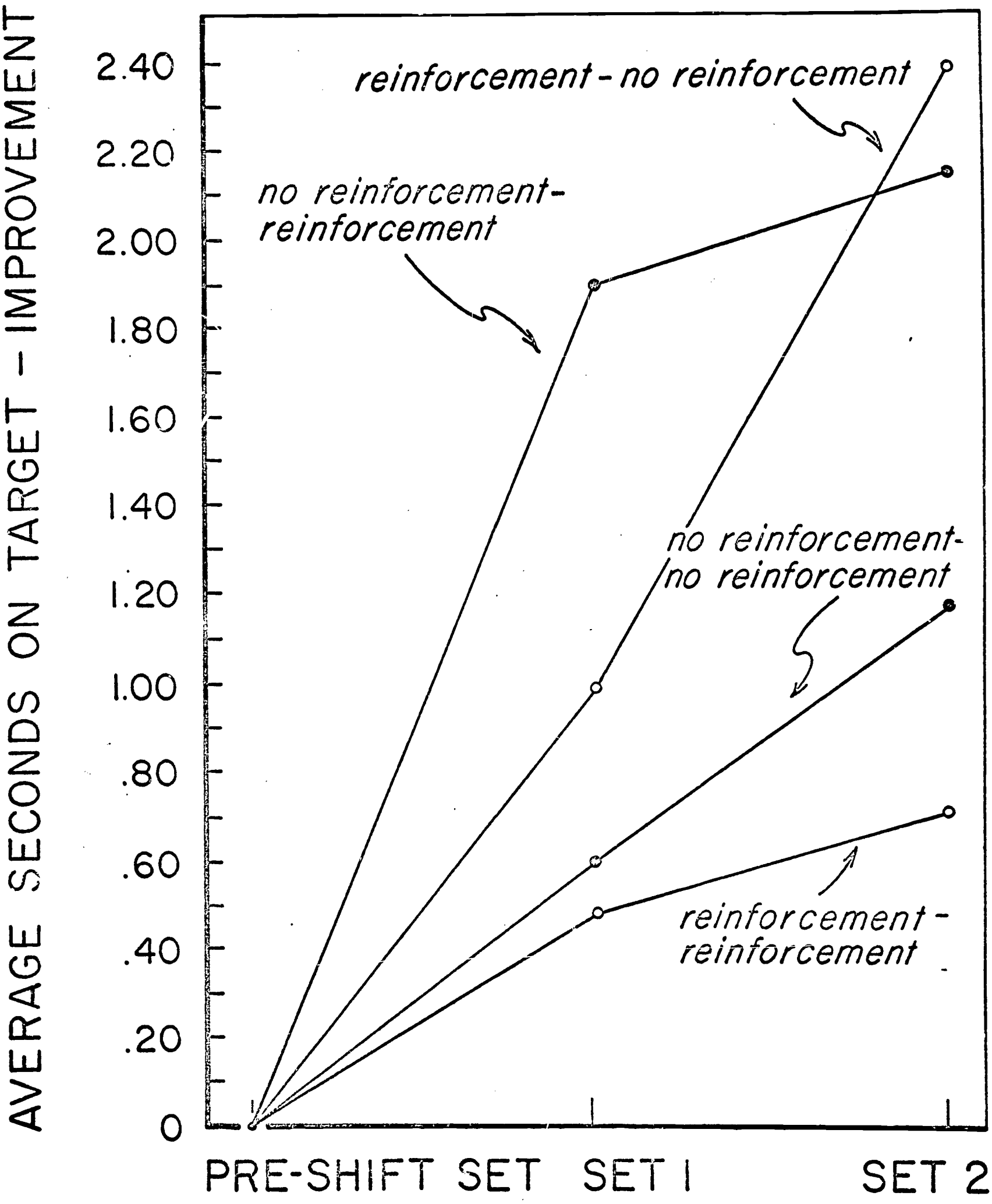
improvement of last two postshift sets over last preshift set. Mann-Whitney tests were conducted on the data, but no significant differences were found.

Experiment IIIB

Method

Subjects. Eighty-eight mild and moderate female retardates were used in this experiment. The subjects were divided into two performance level groups---criterion and asymptotic. The average CAs for the criterion and asymptotic groups were 16 years and 10.3 months and 17 years and 6.3 months respectively. The average IQs were 59.32 and 59.30.

Figure 5


AVERAGE SECONDS ON TARGET - IMPROVEMENT
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
.80
.60
.40
.20
0
reinforcement - no reinforcement
no reinforcement - reinforcement
no reinforcement - no reinforcement
reinforcement - reinforcement
PRE-SHIFT SET
SET 1
SET 2

Procedure. The subjects were divided into two performance level groups---criterion and asymptotic. Criterion was defined as a fifty percent improvement over the average for the first set of five trials. Asymptote was defined as five successive trials on which there was no improvement. These two groups were further divided into four subgroups which differed in the schedule of reinforcement: high-high (HH), low-low (LL), high-low (HL) and low-high (LH). High reinforcement consisted of three M&M candies. Low reinforcement consisted of one M&M candy. The first reinforcement level in the name of each subgroup refers to the level of reinforcement before the appropriate level of performance was reached. The second name refers to the level of reward after the appropriate level of performance had been reached. If the subject reached the appropriate level of performance during a set, she was allowed to complete the set. All subjects received two sets of five twenty-second trials after the performance level had been reached. Those subjects who received a shift in reinforcement were told of it at the start of the first postshift set. Reinforcement took place after each trial which showed improvement. Testing was conducted with the pursuit rotor.

Results

Figures 6 and 7 show the results for the criterion and asymptotic groups. It is apparent that no typical elation or depression effect is

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Figures 6 and 7

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found, except for the LH group in Figure 7. Analysis of variance revealed that the only significant difference was between the criterion and asymptotic groups at the final level of performance ($p < .05$). This indicates that the criterion set for the two levels of performance did lead to clearly different levels of performance.

Figure 6

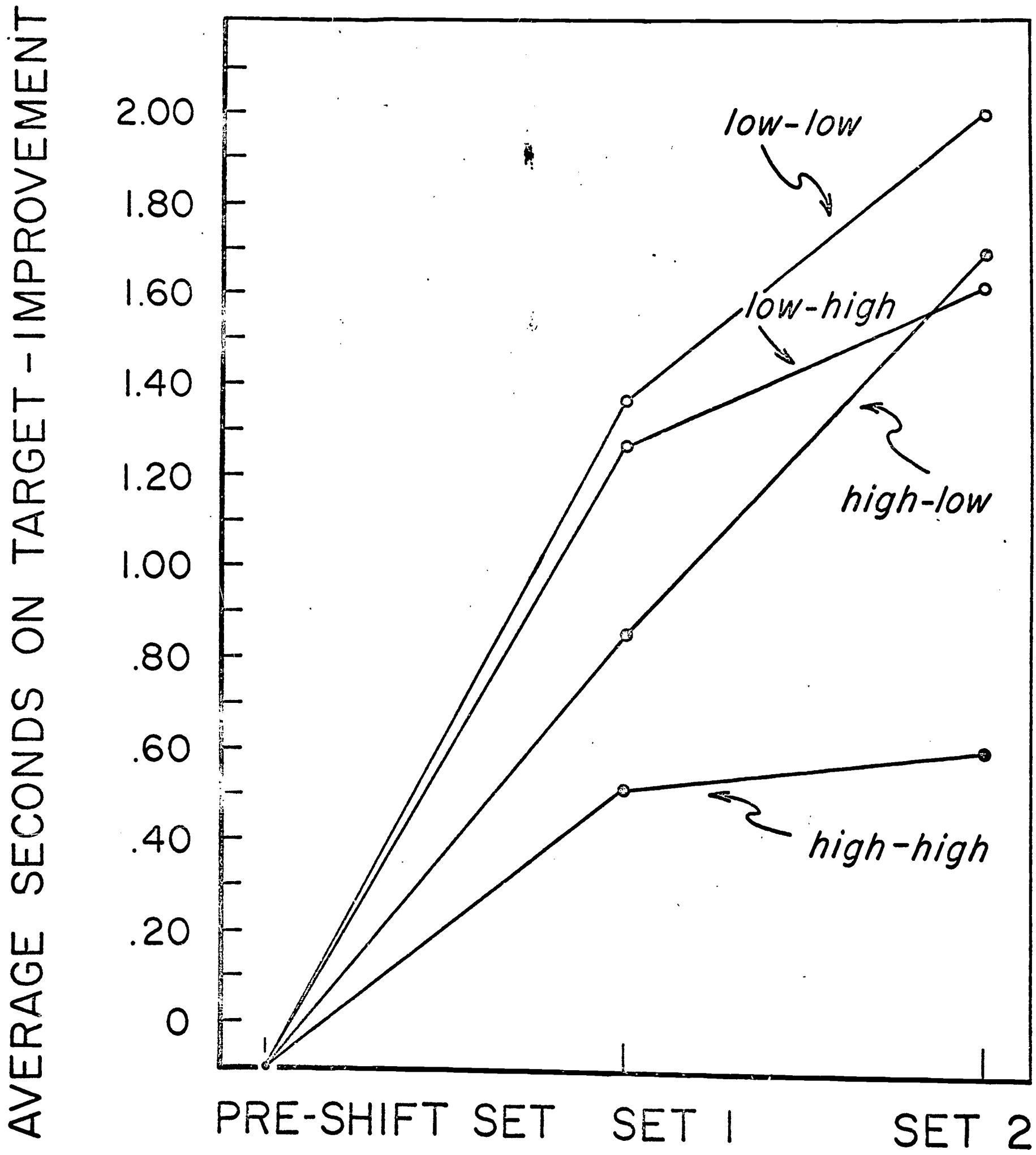
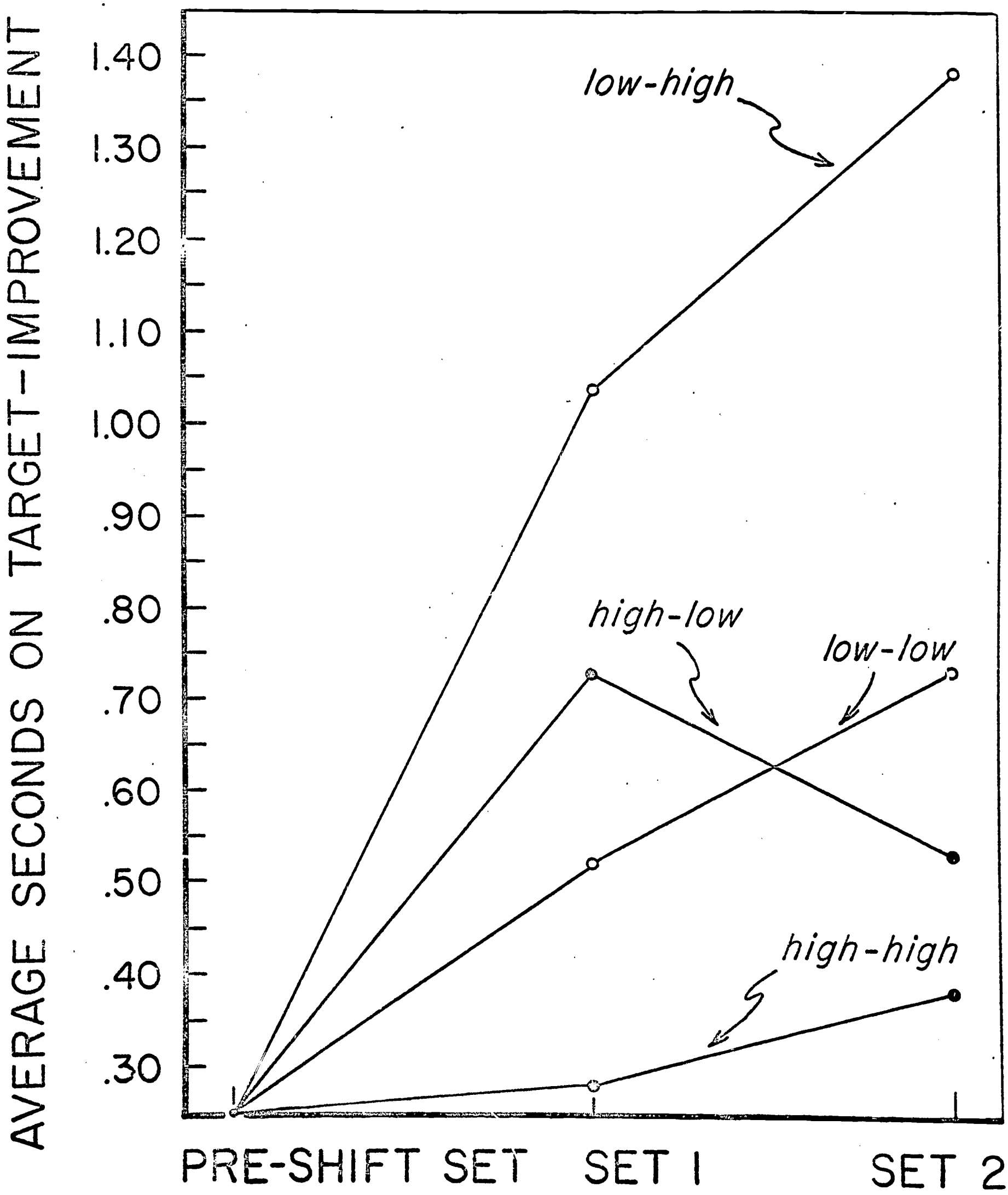

AVERAGE SECONDS ON TARGET - IMPROVEMENT
2.00
1.80
1.60
1.40
1.20
1.00
.80
.60
.40
.20
0
low-low
low-high
high-low
high-high
PRE-SHIFT SET
SET 1
SET 2

Figure 7


AVERAGE SECONDS ON TARGET-IMPROVEMENT
1.40
1.30
1.20
1.10
1.00
.90
.80
.70
.60
.50
.40
.30
low-high
high-low
low-low
high-high
PRE-SHIFT SET
SET 1
SET 2

Correlations were conducted comparing CA and score and IQ and score. Neither of these correlations was significant.

Experiment IIIC

Method

Subjects. Forty-four mild and moderate male and female retardates were used as subjects. There were twenty-four males and twenty females. Table 12 shows the average CA, IQ and MA for these subjects.

Table 12

Procedure. The procedure for this experiment was very similar to that used in Experiment IIIB. The subjects were divided into performance level groups and subdivided into reinforcement schedule groups. Each sub-group consisted of three males and three females or three males and two females. The subjects in this experiment were stopped on the trial on which they reached the appropriate performance level, rather than being allowed to complete the set. They were also informed before testing that there were two levels of reinforcement available to them, depending on their performance.

Results

Figure 8 shows results of the criterion groups in terms of improve-

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Figure 8
---

ment on postshift trials. Figure 9 shows the same data for the asymptotic

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Figure 9
---

groups. Mann-Whitney tests were conducted on all of the data. The only significant difference is between the LH and HL criterion groups ($p < .02$). Although the differences were not significant for other groups, the criterion groups do show a pattern of performance resembling the typical elation and depression effects.

Table 12

	CA (yrs-mos)	IQ	MA (yrs-mos)
Males	14- .9	45.79	5- .2
Females	14-7.5	48.35	5-6.3

Figure 8

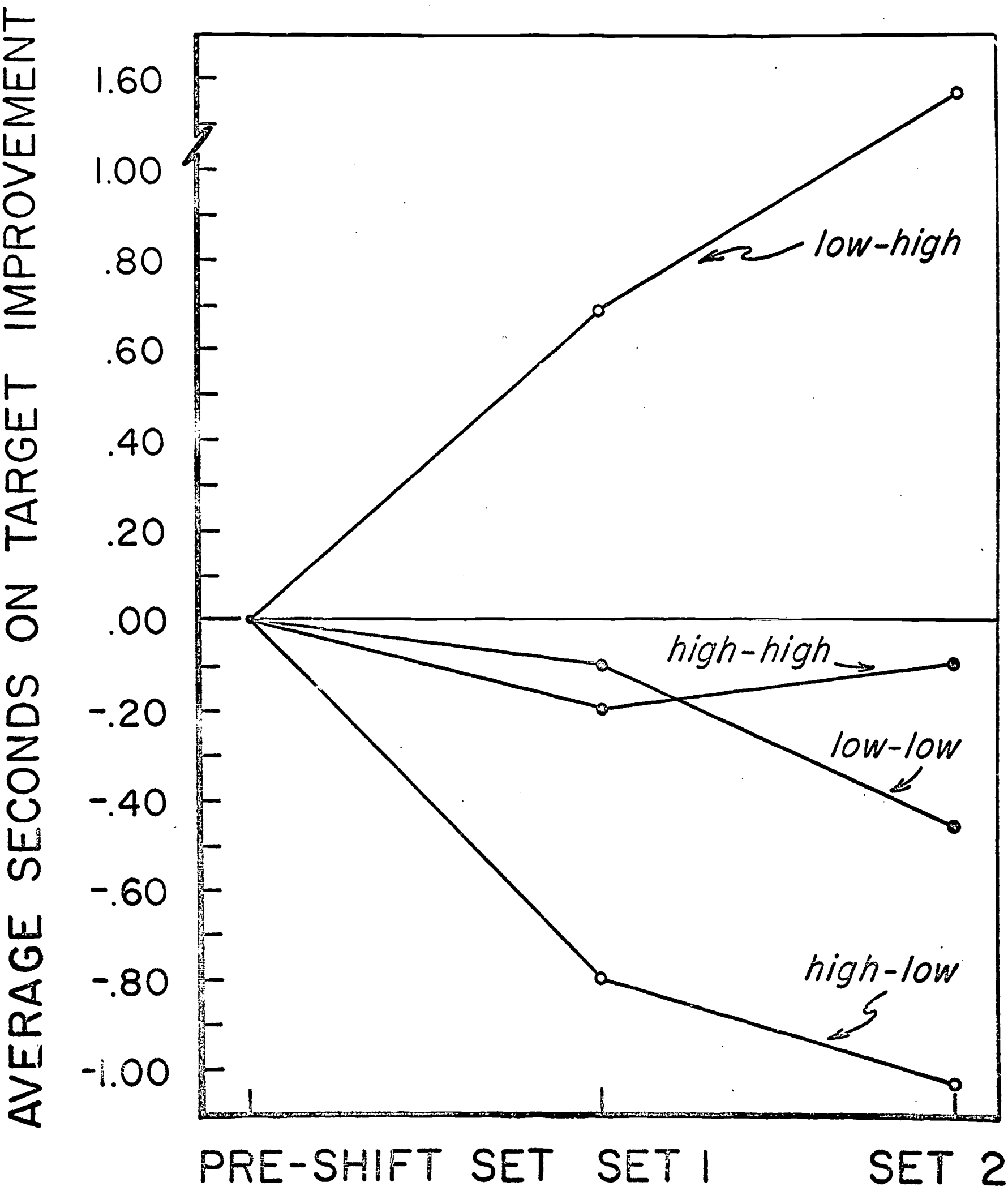
AVERAGE SECONDS ON TARGET IMPROVEMENT
1.60
1.00
.80
.60
.40
.20
.00
-.20
-.40
-.60
-.80
-1.00
low-high
high-high
low-low
high-low
PRE-SHIFT SET
SET 1
SET 2

Figure 9

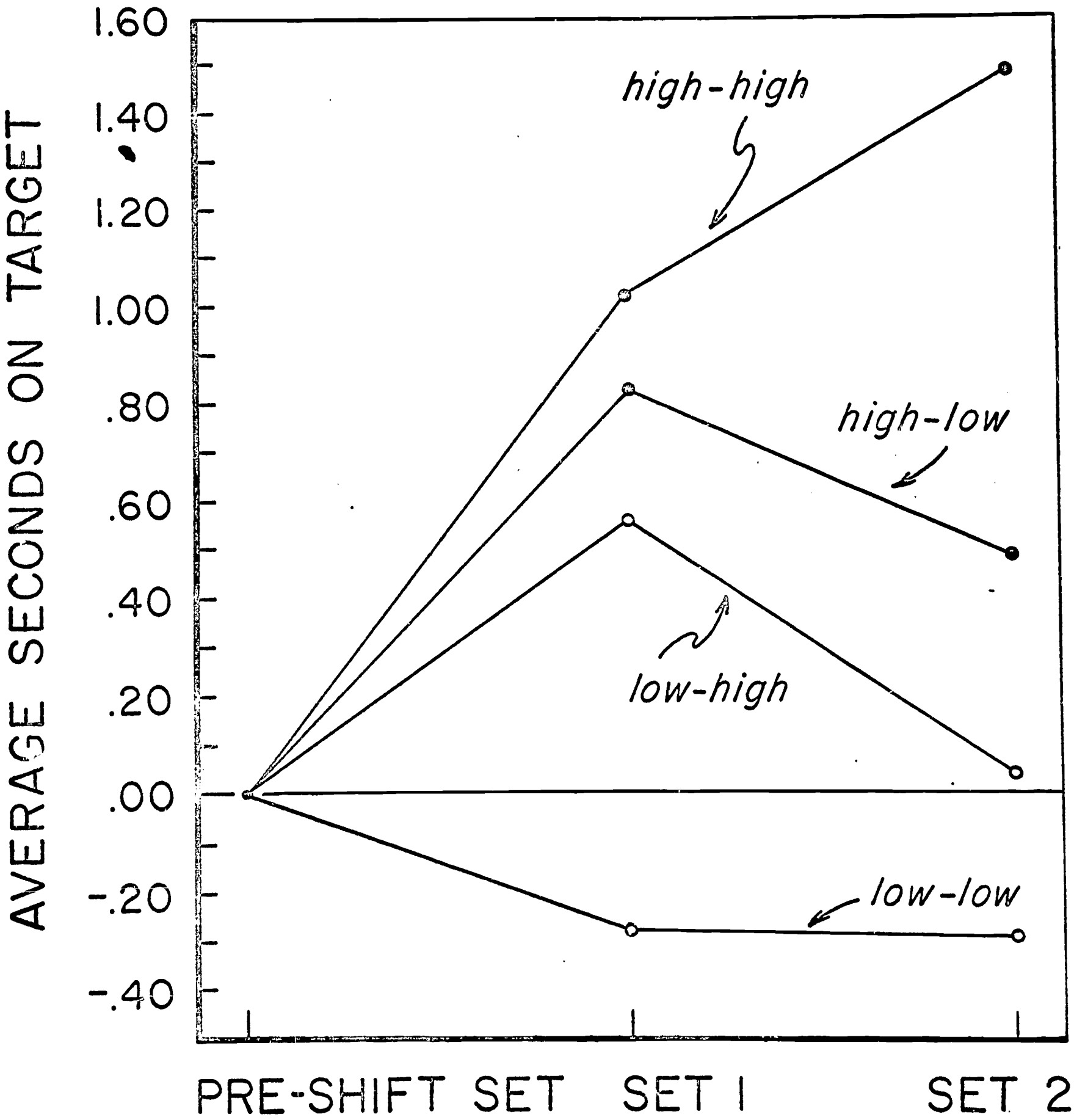
AVERAGE SECONDS ON TARGET
1.60
1.40
1.20
1.00
.80
.60
.40
.20
.00
-.20
-.40
high-high
high-low
low-high
low-low
PRE-SHIFT SET
SET 1
SET 2

Table 13 shows the results of the correlations performed on the

Table 13

data. Score is the average seconds on target per trial for the two post-shift sets. No consistent significant relations were found.

Disscussion

Examination of Figures 5 through 9 indicates that, with the exception of Figure 8, there is no typical Crespi effect. Even Figure 8 does not show the separation between the levels of performance for the HH and LL groups which would be expected.

The fact that the LL subjects in the second experiment (Figures 6 and 7) achieved a higher level of performance than the HH groups is probably due to one of several factors. The first is that the LL and HH groups were not aware that there was another level of reinforcement available. Therefore, the effect of the reinforcement on performance was a result of the value of the reinforcement itself to the subjects, rather than of comparative value. Secondly, the fact that these subjects were teenage girls might have meant that the reinforcement had different values to them than to the younger subjects in the other experiments. The high reward may have been too much for them when given throughout the experiment. That is, they may have received too much candy and become satiated. If this was the case, the candy would have lost its reinforcing value. The lower reinforcer may not have led to satiation, giving it greater reinforcing value. Comments from the subjects partially seem to confirm this viewpoint.

In the third experiment (Figure 8), only the LH group showed any improvement above the preshift average. This may be due to several factors. First of all, these subjects had all had fairly extensive practice on the apparatus over the past year. It may have been, therefore, that their level of performance was subject to less variability

Table 13

		CA-Score	IQ-Score	MA-Score
Male	Criterion	.392	.505	.707**
	Asymptotic	.355	.857**	.790**
Female	Criterion	.552	.515	.600
	Asymptotic	-.524	.758**	.530

** p<.01

and improvement than would normally be expected. Secondly, these subjects had all been tested in other experiments in which the same reinforcements had been used. Their lack of improvement, which is evident also in the asymptotic groups, may have been due to a lack of interest in the entire testing situation. In spite of this, the criterion group in this experiment does tend to show the elation and depression effects, although the only significant difference was between the LH and HL groups.

The most interesting trend is found in the shift groups and their positions relative to the non-shift groups. In all cases, except Figure 8, the shift groups show a greater amount of improvement than at least one of the non-shift groups. In Figures 6 and 7 both shift groups showed more improvement than the HH (RR) group. In Figure 9 they are both superior to the LL group, and in Figure 5 they are superior to both non-shift groups. This phenomenon might be called and "interest effect". That is, any shift in level of reinforcement, whether upward or downward, leads to an increase in performance level of retarded children. The shift in reinforcement seems to renew their interest in the task and to increase their performance. This effect is particularly clear in Figure 5. Here the two shift groups show a greater rate of performance improvement and reach a higher level of improvement than the two non-shift groups. Both the HH and LL groups, although still improving, show much slower rates of improvement.

The results of the correlations shown in Table 13 indicate once again that CA, MA and IQ are not particularly good predictors or indicators of performance level. Although some significant correlations were found, there were not enough to draw any definite conclusions.

Summary and conclusions

Three experiments were conducted in order to examine the effects of shift in magnitude of reinforcement on performance. The effect of performance level achieved before the shift occurred was also examined. Performance level was found to have no effect on whether a typical Crespi effect was achieved. The expected elation and depression effects were not found. However a phenomenon which has tentatively been called the "interest effect" was noted. When a shift in reinforcement level occurred, whether the shift was upward or downward, there was a tendency for the subjects to show greater increase in performance than when no shift occurred.

Experiment IV

Intertrial interval

Experimenters have long been interested in assessing the influence of the intertrial interval (ITI) on both verbal and motor tasks, since (1) the relationship is of considerable importance to the establishment of models of learning, (2) recent data suggest both qualitative and quantitative differences in retention as a function of the time interval between acquisition and retention (Peterson & Peterson, 1959). The quantitative differences suggest that the temporal arrangements between acquisition, retention and, perhaps, between acquisition and retention trials have widespread effects on learning and performance. (3) It is of practical interest to know the most efficient intertrial interval to use in the acquisition of motor skills. Unfortunately for those interested in differences in learning as a function of intelligence, available literature has not been concerned with retarded subjects. Accordingly, the purpose of this experiment was to determine the relation between ITI on a standard motor task and developmental

measures (CA,MA, IQ) and sex.

Intertrial interval and verbal performance

Hovland (1938c, 1939b, 1940a, 1940b) compared the effects of massed (six second ITI) and distributed (two minute ITI) practice on the learning of nonsense syllables. The distributed practice was found to be superior for seial learning, for a two second syllable presentation rate, for retention intervals of six seconds, two minutes, ten minutes and 24 hours, and for various lengths of lists. His failure to find distributed practice superior for a four second syllable presentation rate (1938c) indicates that the more important distribution of practice was the intersyllable interval, rather than the ITI. That is to say that presentation of the stimuli at four second intervals (rather than two second intervals) balanced out the effects of the distribution of trials, leading to a lack of difference between the two ITI's. The importance of the intersyllable interval is also pointed out by another study by Hovland (1938b) and by the work of McClelland (1942). Hovland (1939b) also failed to find that ITI had any effect on the learning of paired-associate lists. This finding is supported by the work of Underwood (1951, 1953a) who used ITI's between two seconds and two minutes long. Riley (1952), however, found distributed practice (two minute ITI) to be superior to massed (eight second ITI) for paired associate syllables. Underwood & Richardson (1957) also found that thirty and sixty second ITI's facilitated paired-associate learning when compared with a four second ITI.

In studying verbal serial learning, the longer ITI (when using intervals between two and 38 seconds) led to superior performance on high and low meaningful lists and on high and low similarity lists (Underwood, 1952; Underwood & Goad, 1951; Underwood & Richardson, 1958; Underwood & Schulz, 1959).

The evidence concerning the effect of length of interval on retention is conflicting. Hovland (1940a), Underwood (1951) and Cain & [redacted]lley (1939) all found that distribution of practice or use of longer ITI's led to superior retention. Underwood (1952, 1953b), however, found that the shorter intervals (two seconds vs. 30, 60 and 120 seconds) led to better recall and relearning. This contradiction cannot be explained by the type of material (serial or paired-associate) or the length of the retention interval since there is overlapping representation of both materials and various intervals in both groups of studies.

Clearly, distributed practice often facilitates verbal learning. But further research is needed to order to discover more precisely the circumstances under which it is most beneficial. Further study of the variables involved in paired-associate learning and retention are particularly important.

Intertrial interval and motor learning.

A large number of experiments have been conducted on the effects of ITI on human motor learning. Using relatively short ITI's from 0 to 120 seconds, many investigators have found that performance improves as the length of the ITI increases (Adams, 1948; Bourne & Archer, 1956; Kimble & Shatel, 1952; McCormack, 1959; Pubols, 1960; Reynolds & Adams, 1953; Reynolds & Bilodeau, 1952). Kientzle (1946) found an increase in performance only up to 45 seconds, although she also tested intervals of 60 and 90 seconds and seven days. This may be due to the type of task which she used (inverted alphabet printing). Pubols (1960) also used this task, but he investigated intervals only up to 40 seconds.

Studies have also been conducted using relatively long ITI's. Travis (1936, 1937b) compared the effects of intervals from five minutes to 120 hours on motor learning. He found that the twenty minute interval was superior. Whe he compared three and seven day intervals (Travis, 1937a), he found no differences. Hardy (1930), however, found a four

day ITI to be superior to twelve hour, one day, two day and three day intervals. This result seems to contradict Travis' findings that the shorter intervals are most beneficial, with the maximum interval for efficiency falling before three days, yet possibly after twenty minutes. The difference in results may be due to the type of task which Hardy used. He tested his subjects on a stylus maze, which requires some memorization, and would therefore possibly lead to some practice during the interval. Travis' pursuit task fairly well precludes the possibility of practice.

The results of these studies indicate that an ITI is useful in the performance of both verbal and motor tasks. They also indicate that when using a relatively short ITI, performance level increases as the ITI increases. Results on the use of a longer ITI are still not clear.

Method

Subjects. Twenty-four mild and twenty-four moderate retardates were used as subjects. One-half of each group was male and one-half was female. The average CA, IQ and MA for the subjects are shown in Table 14.

Table 14

Procedure. A pretest of five twenty second trials, with twenty second ITI, was given to all subjects. Each of the four groups of subjects (mild-male, mild-female, moderate-male, moderate-female) were divided into three subgroups and matched on the basis of CA, IQ, MQ and pretest score. All testing was done on the pursuit rotor apparatus described in Experiment I. An additional timer was wired to the apparatus in order to control the length of the interval.

The three different subgroups were tested with different lengths of intertrial interval: Group A had a five second ITI, Group B had a twenty second ITI, and Group C had a fifty second ITI. All subjects

Table 14

		CA (yrs-mos)	IQ	MA (yrs-mos)
Mild	Males	13- 9.9	59.42	7-2.0
	Females	13-11.0	58.92	6-9.2
Moderate	Males	14- 5.7	45.58	5-4.5
	Females	15- 3.1	44.67	5-5.2

received five twenty second trials per set with the appropriate ITI. They all received three sets of trial, with an interset interval of one minute. The subjects were brought individually to the testing room and were shown how to use the apparatus. All of the subjects had previous experience with the pursuit rotor, so no practice trial was given.

Results

Figure 10 shows the results. When considering the mild retardates,

---
Figure 10
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the males and females show opposite effects as a result of ITI. The difference between the sexes for the five second interval was significant at the .05 level by the Mann-Whitney test. The other differences were not significant. None of the differences in the moderate groups were significant.

Analysis of variance was conducted on the results in terms of average seconds on target per trial (Table 15). The only significant

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Table 15
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difference which was found was between the two degrees of retardation, with the mild retardates performing at a significantly superior level.

Correlations were run between CA and score, IQ and score and MA and score for the four groups. The only significant correlation was between MA and score for the mild female group ($p<.05$).

Discussion

The results of the analysis of variance clearly show that there is a difference in performance level between mild and moderate subjects, with the mild groups reaching a superior level of performance. This confirms the results of previous studies.

The independent variable had a much greater effect on the mild

Figure 10

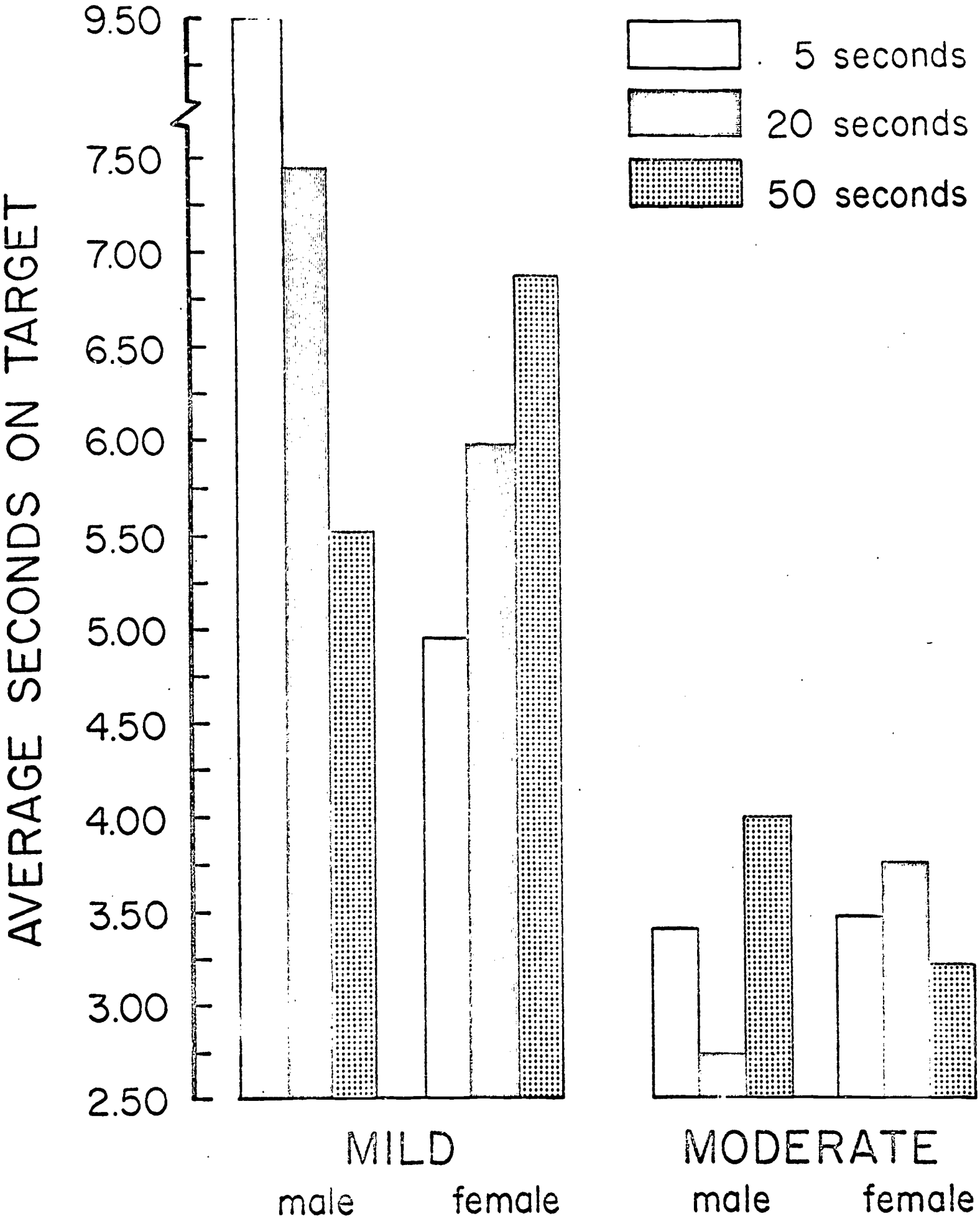
AVERAGE SECONDS ON TARGET
9.50
7.50
7.00
6.50
6.00
5.50
5.00
4.50
4.00
3.50
3.00
2.50
5 seconds
20 seconds
50 seconds
MILD
male
female
MODERATE
male
female

Table 15

Source	Sums of squares	df	Mean square	F	p
A (sex)	6.332	1	6.332		
B (intertrial interval)	1.637	2	.818		
C (retardation)	129.560	1	129.560	7.506	$<.01$
A X B	14.296	2	7.148		
A X C	8.158	1	8.158		
B X C	3.074	2	1.537		
A X B X C	24.189	2	12.094		
Within	621.426	36	17.262		
Total	808.672	47			

retardates than on the moderates. Although the only significant difference (as far as the independent variable was concerned) was found between the mild male and female retardates for the five second interval, all differences in the mild groups were larger than those for the moderate groups. This seems to indicate that there may be a correlation between IQ and the effect of ITI, if a wide range of IQs is considered. The results of experimentation with normal human subjects reported in the introduction show more clear-cut differences as a result of ITI. It may be that as the IQ decreases, the effect of this variable on performance also decreases.

The lack of significance in this experiment may have been caused by two factors. The length of the interset interval was one minute. It may be that this rest partially balanced out the effects of the ITI. The effect of the interset interval may be seen to have an effect similar to the intersyllable interval reported by Hovland (1938a, 1938b).

The second factor which may have contributed to the lack of signigicance has to do with the problems of matching and with the somewhat random variability in retardate performance. Although all subjects were pretested on the pursuit rotor and the groups were matched on the basis of this pretest, the great variability found in retardate performance may have made the groups unequal during experimental testing despite pretest matching.

The correlations yeilded no significance except for the female mild group for the MA-score correlation. This again seems to indicate than within fairly restricted groups the CA, IQ and MA of the subjects are not good predictors of motor ability. In spite of the fact that IQ may be used to predict differences between widely divergent groups (significant differences between mild and moderate retardates on performance), it seems to be ineffective for finer discriminations.

2

Summary and conclusions

This experiment was conducted to examine the effects of intertrial interval (ITI) on motor performance in retardates. Intervals of five, twenty and fifty seconds were tested. The effects of sex and degree of retardation on motor performance were also examined. The following results were found:

1. ITI seems to have no significant effect on the performance of moderate retardates. In male mild retardates, the performance level decreases as the length of the interval increases. This relationship is reversed for the female mild retardates. None of the differences for the male or female mild retardates were significant.

2. Significant differences were found between the performance level of the mild and moderate retardates, with the mild retardates performing at a superior level.

3. No significant differences in performance were found between the sexes in the analysis of variance.

4. Correlations between CA, IQ and MA and score failed to yield any consistently significant relationships.

Experiment V

Reminiscence

Reminiscence refers to the phenomenon that recall is superior after a short rest than immediately after acquisition. Reminiscence in verbal learning has been studied extensively. Hovland, using a rote learning task, found that a two minute rest interval led to reminiscence for serial lists (1939a) and for a two second syllable presentation rate (1938b). When comparing reminiscence for massed and distributed practice, it was found that massed practice led to greater reminiscence (1936, 1938a). Hovland failed to find a reminiscence effect for the four

second syllable presentation rate (1938b) and for paired associate lists (1939a). McClelland's findings (1942) seem to confirm Hovland as to the effects of longer syllable presentation rates. These studies on syllable presentation rate and on massed and distributed practice seem to indicate that distribution of practice has the same effect as the rest pause which leads to reminiscence. The failure to find reminiscence for paired associate lists further comfirms this, for the learning of paired associate lists is not facilitated by distribution of practice.

In further studies on reminiscence, the effect has been found for thirty second intervals (McGeoch, McKinney & Peters, 1937) and for six second intervals (Melton & Stone, 1942). Melton and Stone, however, failed to find reminiscence for two, five and twenty minute intervals. The fact that Hovland obtained reminiscence for a two minute interval may be due to the difference in the materials used for the acquisition.

Reminiscence has also been studied in connection with the learning of prose passages. Edwards (Edwards, 1935; Edwards & English, 1939a; English & Edwards, 1939) found reminiscence on summary items (those items requiring only general recall of the learned material) for intervals up to ninty days. Forgetting occurred, however, for the verbatim items(those requiring specific detailed recall of the learned material). In another experiment, Edwards & English (1939b) found summary reminiscence to reach a maximum at ten days. These studies clearly point out that although the maximum interval for reminiscence following rote learning is short, the maximum interval for summary retention may be quite long.

One of the major problems involved in the study of reminiscence, as has been pointed out by English & Edwards (1941), is that of practice effects. McGeoch (1935) attempted to solve the problem by comparing subjects who admitted reviewing and those who did not. The results,

surprisingly, show that the no-review groups showed more reminiscence. Further indication that practice has little influence in reminiscence comes from studies with animals (Magdsick, 1936; Teichner & Holder, 1952).

Studies in motor learning also partially eliminate problems of practice. In verbal tasks, the subject can mentally review the material which was learned during the interval. In motor learning, however, mental practice probably does not occur. Those studies which have used motor learning (Ammons, 1947; Ammons, Alprin & Ammons, 1955; Buxton, 1943; Ellis, Montgomery & Underwood, 1952; Grice & Reynolds, 1952; Irion & Gustafson, 1952; Kimble & Horenstein, 1958; Rockway, 1953) indicate that reminiscence occurs in motor learning for intervals up to ten minutes, with ten minute interval being maximally effective. Melton (1941), however, has found a twenty minute interval to be effective and Travis (1937b) found the twenty minute interval to be superior to a five minute interval. In general it may be said that rote verbal learning has the shortest interval for effective reminiscence and summary verbal learning has the longest effective reminiscence interval. The maximal interval for motor learning appears to fall somewhere between the other two.

The relationship between distributed practice and reminiscence is also found in motor learning. Bourne (1956) found no significanct reminiscence when subjects practiced under ITI's of more than fifteen seconds. Pubols (1960) found reminiscence to decrease as ITI increased. Duncan (1951), however, found massed and distributed groups to show almost equivalent reminiscence. This may have been due to the design of his experiment and the manner of presentation of results.

Most of the studies on reminiscence in which human subjects have been used have tested college students. This experiment studied retarded children in order to discover if the phenomenon exists in this

group of subjects.

Method

Subjects. Forty mild retardates were used in this experiment. The subjects were all females between 13 and 18 years old.

Apparatus. A standard memory drum was used for presentation of the words. The words used in the experiment were:

LIP-BAR	MUD-GAS
NET-DOG	RIP-DAD
SOB-HAY	TOY-NAP
CAB-FIT	GUN-COW
LOG-PET	COP-BUG

Procedure. The subjects were divided into two matched groups on the basis of CA and IQ. One group served as the control and one as the experimental group. Each of these groups was then further divided into two subgroups. One of these subgroups learned the words to a criterion of one perfect recitation; the other learned to a criterion of 50% correct. Table 16 shows the average CA and IQ of the groups.

Table 16

The subjects were brought individually to the testing room. Before testing, all subjects were instructed to name colors for two minutes. This same task was given to the experimental group during the rest period so that they would be unable to review the list of words. The color-naming task was given to all subjects prior to testing so that if it had any effect on the learning, the effect would be present in both groups. The subjects were presented with the memory drum apparatus, which was briefly explained. The first list which was presented to the subjects showed both words of the pair together. These were read by the experimenter and shown to the subject only once. The testing

Table 16

		CA (yrs-mos)	IQ
Control	50%	17-3.0	61.90
	100%	17-4.3	61.90
Experimental	50%	17-3.2	61.80
	100%	17-2.9	61.80

then began and the second list was explained and presented to the subject. This list presented the pairs of words one word at a time. The subject was told to name the second word of each pair when she saw the first word. The subject was also told that the second word would then appear so that she could find out if she were right or wrong. This list was continually presented until the appropriate criterion was reached. At this point the control groups were presented with the third list which contained only the first word of each pair. They were instructed to give the second word of the pair when they saw the first. They were also told that they would not see the second word and so would not know if they were right or wrong. The subjects were given ten recall trials. The experimental groups, after reaching the appropriate criterion, were again instructed to name colors for two minutes. The were then given ten recall trials.

Results

T-tests were conducted on the data. No significant differences were found. Figure 11 shows the average number of syllables correct

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Figure 11
---

on the last test trial, in terms of the criterion which had been set, and on the ten recall trials. There is no typical reminiscence effect, for the recall trials never reach a level above the last test trial.

Figure 12 shows the range of scores for the data shown in Figure

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Figure 12
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11. It is obvious that some of the subjects in both the experimental and control groups show reminiscence.

Table 17 shows the correlations which were performed on the data.

Figure 11

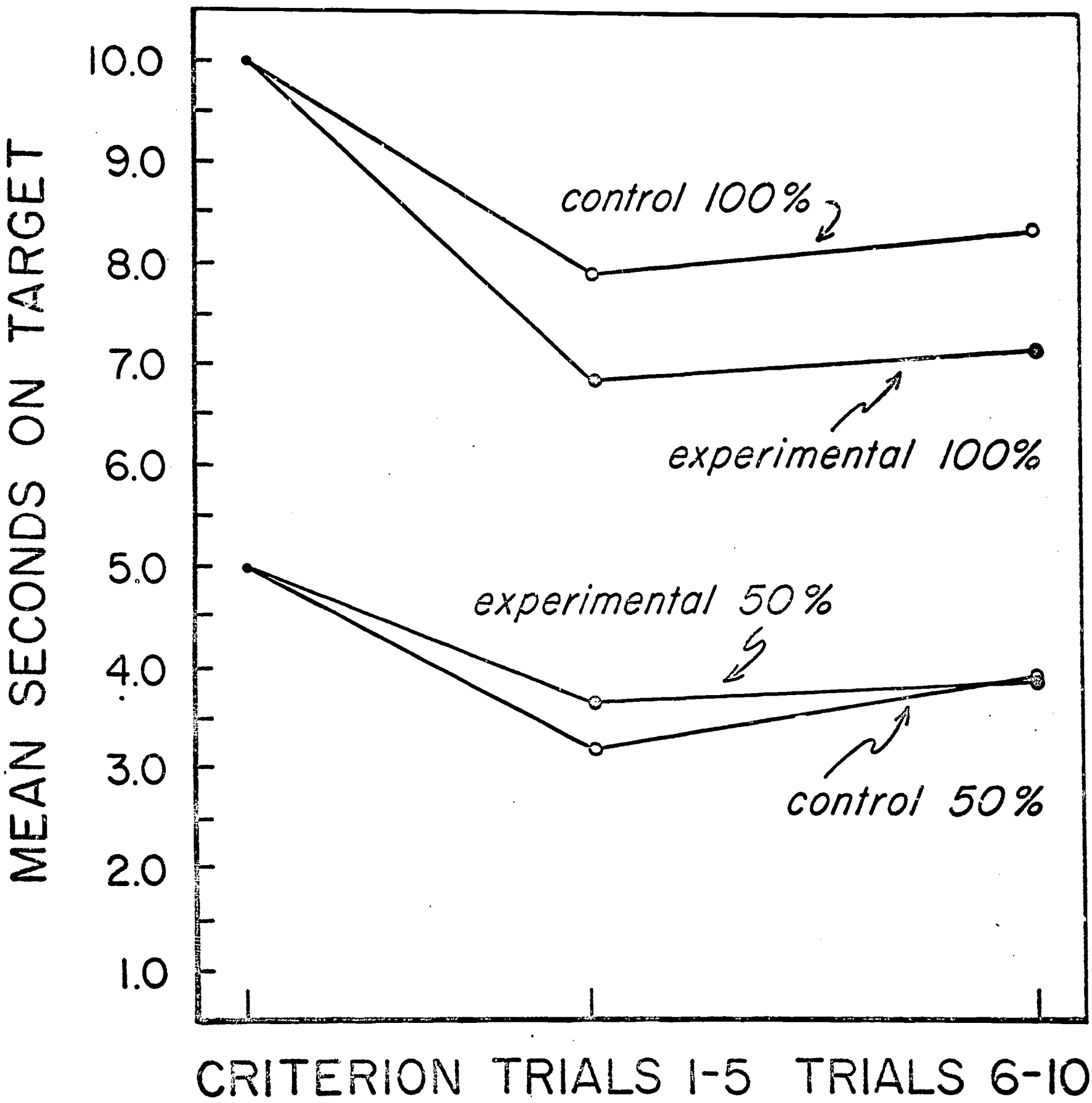
MEAN SECONDS ON TARGET
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
control 100%
experimental 100%
experimental 50%
control 50%
CRITERION TRIALS 1-5 TRIALS 6-10

Figure 12

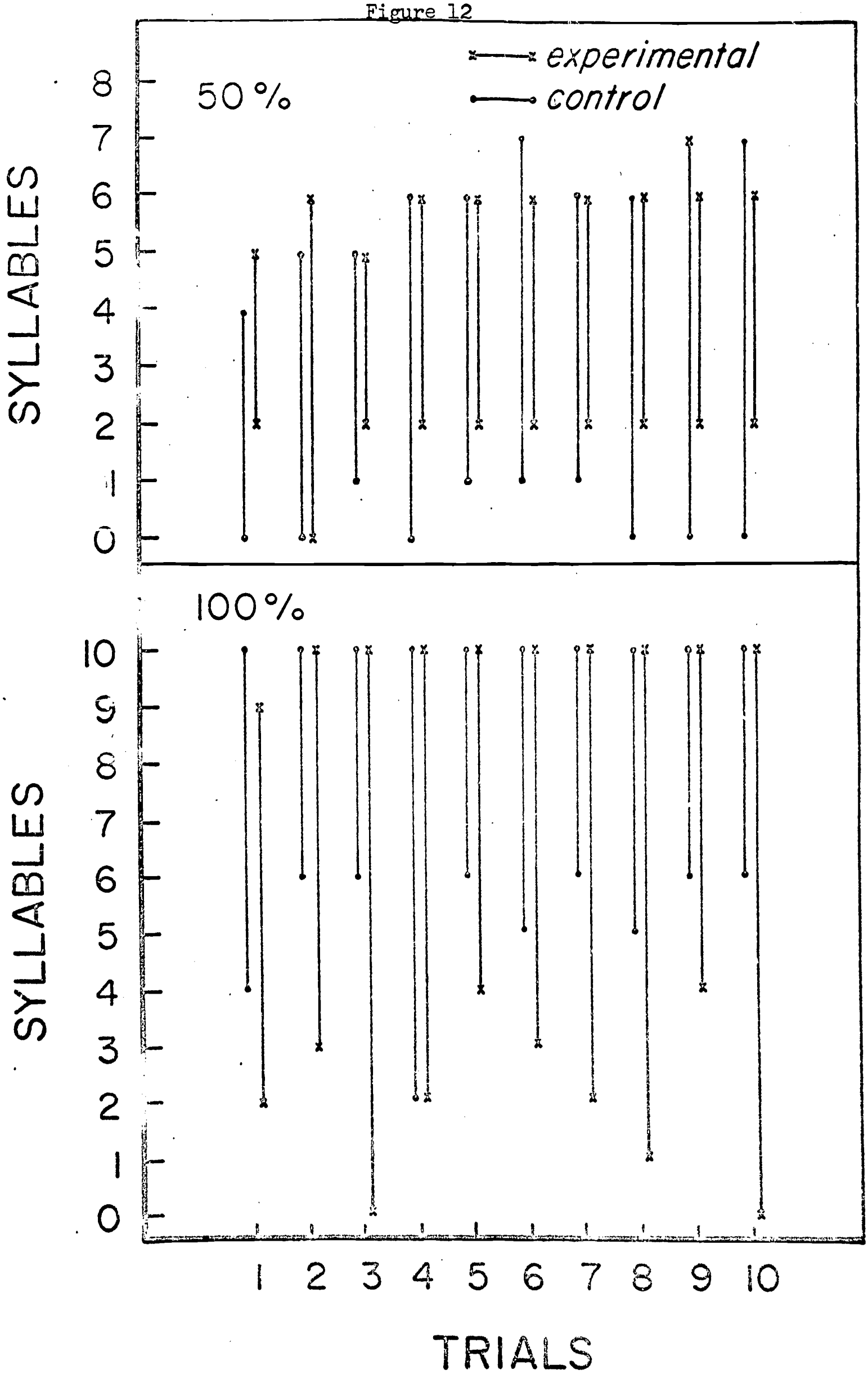
experimental
control
50 %
100 %
SYLLABLES
0
2
3
4
5
6
7
8
9
10
1
2
3
4
5
6
7
8
9
10
TRIALS

Table 17

Acquisition was measured in terms of number of trials to criterion. Retention was measured in terms of number of syllables correct per trial during the ten recall trials. The correlations involving acquisition would therefore be expected to be negative; i. e., the higher the CA or IQ, the fewer the number of trials to criterion. The correlations for retention would be expected to be positive. The only significant correlations were for the experimental 100% group (IQ and acquisition, acquisition and retention) and for the control 100% group (acquisition and retention).

Discussion

Figure 11 shows that over-all there was no typical reminiscence effect. However, it is interesting to note that all four groups show improvement on the last five retention trials over the first five. The repetition of the pairs, even when the correct answers were no longer given, led to improvement in the recall scores. Although these differences are not significant, the consistency of the finding makes it worth noting.

The ranges of syllables recalled are graphed in Figure 12. The figure shows that reminiscence did occur in the performance of some subjects. Five subjects in the experimental groups showed reminiscence on at least one of the recall trials; only three of the control subjects achieved levels above the acquisition criterion. Although this difference is not significant, it does indicate that the experimental two minute rest pause did tend to lead to an increase in the number of subjects showing reminiscence. This is confirmed by the slight superiority of the experimental 50% group over the control 50% group as seen in Figure 11. This superiority indicates that there was a slightly

Table 17

		CA-Acq.	CA-Ret.	IQ-Acq.	IQ-Ret.	Acq.-Ret.
Control	50%	.479	.082	-.345	.088	.091
	100%	-.200	.124	-.388	.255	-.779**
Experimental	50%	-.380	.164	.000	.024	-.127
	100%	.030	-.197	-.636*	.248	-.742**

* $p < .05$

** $p < .01$

greater amount of material retained in the experimental group. The relationship between the 100% groups, however, is reversed. Both Figure 11 and Figure 12 show that there is more forgetting in the experimental group than in the control group. This may be explained by the fact that the greater amount of material is more difficult for the subjects to learnand to retain. It may be that when the amount of material learned reaches a certain level, immediate retention is more beneficial than retention after a brief rest pause.

The correlations shown in Table 17 point out that neither IQ nor CA are very accurate predictors of performance level in a verbal task. It is interesting that only two of the correlations between acquisition and retention are significant. These correlations do not even approach significance for the 50% groups. This seems to confirm what was pointed out above in reference to the difference between the 50% and 100% groups. There seems to be a difference in the relation between acquisition and retention, depending on the amount of material learned.

Summary and conclusions

This experiment was conducted to determine if reminiscence occurs in retardates. The subjects were tested on a paired-associate verbal task. Half of the subjects learned to a criterion of 50%; the other half learned to 100% criterion. The experimental group was tested for recall two minutes after criterion was reached; the control group was tested for retention immediately after criterion was reached.

The following conclusions may be drawn from the data:

1. Although the averages of the subjects' performances do not show a reminiscence effect, the effect is present in the performances of some of the individual subjects in the 50% groups. More subjects in the experimental group showed reminiscence than in the control group.

2. The recall scores for the experimental 50% group were

generally higher than those for control 50%. The reverse was true for the 100% groups.

3. The correlations which compared CA and IQ with acquisition and retention failed to show any significance, indicating than neither CA nor IQ are accurate predictors of verbal learning ability. Correlations between acquisition and retention also failed to show consistent significant results. This seems to indicate that acquisition scores in verbal learning tasks are not as good as predictors of retention as they are in motor tasks.

General summary and conclusions

This paper includes a series of five studies which were conducted in order to examine several attributes of retardate learning. The studies were concerned with (1) the influence of the type of reinforcement, (2) the effect of duration of delay of reward on performance, (3) the effect of altering the quantity of reinforcement, (4) the effect of different durations of intertrial interval and (5) reminiscence.. The effects of sex, CA, IQ and MA on performance were also studied.

In studying the type of reinforcement and reminiscence the results resemble those derived from examination of normal subjects. The type of reinforcement does have a differential effect on the performance of retardates; objective reward was found to be significantly superior to verbal reward in two experiments. Although the reminiscence study did not show reminiscence for the groups as a whole, there was evidence that some individuals showed a reminiscence effect. Similar findings have been noted in studies with normal subjects. It was also noted in this study that there was a relationship between the efficiency of different lengths of retention intervals and the amount of material learned. For the subjects who were required to reach only a 50%

criterion, the two minute retention interval led to better retention than the immediate retention test. The opposite effect was found when the subjects were required to learn to a 100% criterion.

In the Crespi study (quantity of reinforcement), intertrial interval and delay of reward studies, however, the results failed to agree with those found in the literature for normal subjects. Studies examining a shift in the quantity of reinforcement generally failed to show the expected elation and depression effects. However, a phenomenon, which has been tentatively called the "interest effect", was noted. This effect refers to the trend which was noted in the shift groups in which a greater improvement rate occurred after shift, regardless of whether the shift represented an increase or a decrease in reinforcement, than did the non-shift groups.

The delay of reward study failed to show that there was an inverse relation between length of delay and level of performance. The one second (shortest) interval group did perform better than the ten second group in general, but the relations between the other groups did not follow the expected pattern.

Intertrial interval also failed to follow the expected pattern in regard to the relation between ITI and performance. Only the female mild retardates showed the expected increase in performance as the length of the interval was increased.

Examination of the relation between sex and performance revealed that the males perform at a consistently higher level on motor tasks than do females. It was also noted that, in general, the effects of the sex difference tend to decrease as the degree or severity of retardation increases. In other words, there is a clearer differentiation between the performance of the sexes in the subjects with the higher IQ levels.

The relation between sex and degree of retardation (i. e., that

the sex differences decrease as the degree of retardation increases) was also found in the acquisition and retention differences, delay of reward and intertrial interval. Although the correlations indicate that IQ is not a very good predictor of performance within a an IQ group such as milds or moderates, it appears that IQ may be used to predict certain types of behavior when dealing with wider ranges of IQ variation.

Correlations conducted on the data to examine the relation between MA, CA and IQ and performance failed to show any consistent relationship. It seems apparent that whatever factors the IQ tests measure have little relation to the subjects ability to perform a motor task.

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